Set 1. Significant Figures

Skill 1.01: Be able to estimate the uncertainty in a measurement
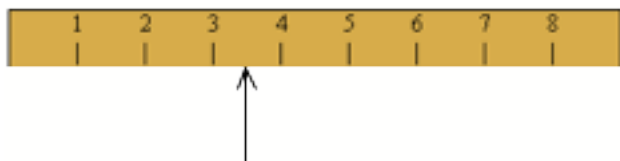**Skill 1.02: Be able to identify the number of significant figures in a measurement**
Skill 1.03: Be able to round a measurement to the correct number of significant figures

Skill 1.01: Be able to estimate the uncertainty in a measurement

Skill 1.01 Concepts

The uncertainty in a measurement always lies in the estimated digit. That is, the digit farthest to the right.


The measurement above could be reported as 3.4 cm or 3.5 cm. The uncertainty would therefore be reported as $\pm$ 0.1 cm. The "$\pm$" value for the purpose of this course can be a subjective figure. For example, a student may have very well decided that the uncertainty was $\pm$ 0.2 cm. In either case, uncertainty is important because it provides a range of acceptable measurements and informs the reader of the quality of the data obtained.
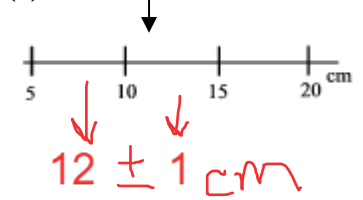
Skill 1.01 Example 1

(a) Record the measurement for each of the following (INCLUDE UNITS!)
(b) Identify the uncertainty Uncertainty is the "give or take" in the measurement

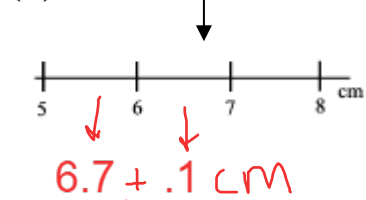| (I)	(ii)	(iii)
5.08 give or take .01 5.08±.01 cm	12 ± 1 cm	6.7 ± .1 cm
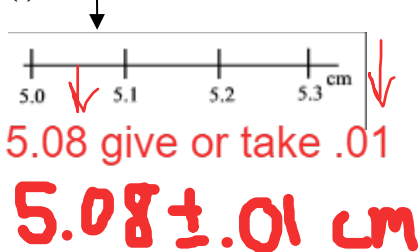
Skill 1.01 Example 2

How many jelly beans are in the jar? What is the uncertainty? What could you do to reduce the uncertainty?

1200 give or take 200
1300 +/- 300
1400 +/- 400
1000 +/- 100

Supplies
- sample of 100 jelly beans
- ruler
- mass balance
- empty jar of jelly beans

Skill 1.02: Be able to identify the number of significant figures in a measurement

Skill 1.02 Concepts

The significant figures in a number communicate all the digits known in a measurement plus one estimated digit. Consider the measurement taken using the ruler below.
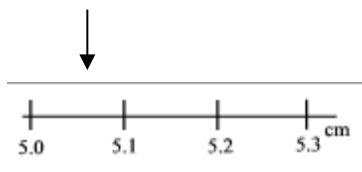
Because the measurement lies between the 5.0 and the 5.1, the "5" and the "0" are known digits and are therefore significant. The last digit in the measurement must be estimated however. 5.07 cm would be an appropriate reported value. The total number of significant figures in the measurement is therefore 2 + 1, or 3.

Skill 1.02 Example 1

(a) Record the measurement for each of the following (INCLUDE UNITS!)
(b) Identify the number of significant figures

(i)	(ii)	(iii)
5.12 3 s.f.	12 2 s.f.	.6 0.6 1 s.f.

Often times, we need to be able to determine the number of significant figures by simply looking at a measurement.

The following rules are very useful for determining the number of significant figures in a measurement.

> I.   All nonzero digits ARE significant (123456789)
> II.   All trailing zeros ARE significant IF a decimal is present (1.200, 1.000, 100.0, 500.)
> III.   All captive zeros ARE significant (101, 2.001, 200.001)

Skill 1.02 Example 2

How many significant figures are in each of the following measurements?				
(a) 20.201 g	(b) 0.00102 g	(c) 200 g	(d) 0.000001 g	(e) 50000. mL
3 non zero digits	2 non zeros	1 non zero	1 non zero	1 non zero
0 trailing zeros	0 trailing	0 trailing	0 trailing	4 trailing
2 captive zeros	1 captive	0 captive	0 captive	0 captive
5 s.f. total	3 total s.f.	1 s.f.	1 s.f.	5 s.f.

Skill 1.03 Concepts

The procedure for rounding measurements is as follows.

- If the first digit following the point of rounding off is less than 5, simply drop the digits that follow.   Thus, 8.724 to 3 significant figures rounds off to 8.72.
- If the first digit following the point of rounding off is equal to or greater than 5, add 1 to the preceding digit. Thus 8.727 to 3 significant figures rounds off to 8.73.

Skill 1.03 Example 1

(a) Round 1.08 to the tenths.	(b) Round 1.1499 to the thousandths	(c) Round 1.998 to the tenths	(d) Round 2.9009 to 3 significant figures
1.1	1.150	2.0	2.90

Skill 1.03 Exercise 1